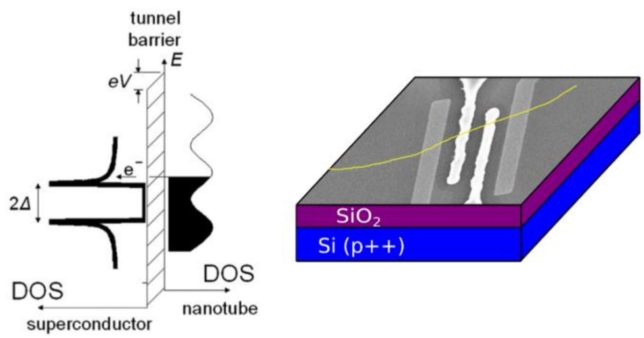
NANOHOUR

Wednesday, October 10, 2012 3:00 pm
Beckman Institute - Room 2269

Superconducting Tunnel Probe Spectroscopy of Carbon Nanotubes

Nick Bronn, Physics

Graduate Student with Professor Nadya Mason



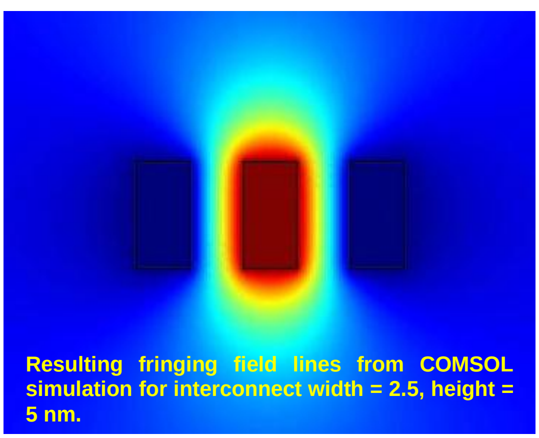
Due to their reduced dimensionality, electron transport in Carbon Nanotubes is thought to be described by Luttinger liquid theory, where electron-electron interactions are important as compared to the non-interacting electron picture of Fermi liquid theory, which accurately describes most conductors. Superconducting tunnel probes, which have a sharp peak in the density of states (DOS) outside the gap, are used to measure the DOS of carbon nanotubes. In order to elucidate information about electron-electron scattering and energy relaxation processes not apparent in the DOS, the nanotube is biased out of equilibrium to determine the electron distribution function. This talk will include recent measurements studying these interactions by varying non-equilibrium bias, length dependence, and temperature.

CVD Graphene Interconnects

Ning Wang, Electrical and Computer Engineering

Graduate Student with Professor Eric Pop

As CMOS device dimensions scale down, metal interconnect delay rises rapidly due to increased carrier scattering with interconnect sidewalls and coupling capacitance between metal lines. Graphene nanoribbons (GNRs) are an attractive replacement due to excellent electrical transport properties and two-dimensional confinement—features which mitigate size-dependent electrical effects. In this talk, I will present both modeling and experimental work from our group to explore the potential benefits of GNR interconnects. I will overview modifications to existing resistivity models and finite-element simulation results of various geometries in COMSOL. I'll then compare resistive-capacitive (RC) time delays of copper (Cu) and aluminum (Al) interconnects with graphene nanoribbons (GNR) in the sub-50 nm regime and show that GNR performance dominates at line widths smaller than 10 nm.



Resulting fringing field lines from COMSOL simulation for interconnect width = 2.5, height = 5 nm.

I'll then discuss separate experimental work in which single-layer GNRs of widths $W < 100$ nm and lengths $L < 800$ nm are fabricated from chemical vapor deposited (CVD) grown graphene. Low and high-field measurements are performed on these devices over a temperature range of 1.7 to 900 K, yielding current densities as high as $\sim 2 \times 10^9$ A/cm^2 at high fields. For $L < 100$ nm, transport appears to be contact dominated rather than by edge roughness, defects, or grain boundaries, supporting the notion that GNRs are less influenced by size-dependent electrical effects. However, variability and poor contacts issues remain, preventing full implementation of high-performance GNR interconnects.

Coffee and cookies will be served

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